REMARKS

In view of the following remarks, reconsideration and further examination are respectfully requested. Claims 18-19, 21, 25, and 27-35 have been rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent Pub. No. 2003/0092560 by Von Blucher, in view of U.S. Patent No. 4,273,619 by Angelo II.

Concept of the Present Invention

The present invention is directed to a method which produces an entire carbonization operation with its various process steps or sectors carried out at different temperatures in just a single apparatus which includes a plurality of temperature zones or temperature gradients for this purpose. This makes it possible to perform the carbonization operation continuously, i.e. without any interruption, in particular without the apparatus being changed. Carried out in this manner, the claimed method is simpler, more efficient, and more economical.

According to the present invention, the introduction of additional sulfonic acid groups, through a sulfonation process, can be carried out directly in the carbonization apparatus, upstream from the carbonization operation. As described, the method provides for the two stage operation, including sulfonation and carbonization, to be carried out in a continuous manner within a single apparatus. The ability to introduce chemical groups during carbonization that can lead to free radicals during carbonization and affect cross-linking allows the use of less costly starting materials. The presently claimed invention offers the advantage that the entire smoldering or carbonization operation, i.e. pre-carbonization plus post-carbonization, and additionally the preceding sulfonation operation can be operated continuously in a single apparatus. This inventive concept is, however, neither disclosed nor rendered obvious by the cited prior art references.

The rejection of claims 18-19, 21, 25, and 27-35 as being unpatentable over U.S. Patent Pub. No. 2003/0092560 by Von Blucher, in view of U.S. Patent No. 4,273,619 by Angelo II.

According to the Office Action:

With respect to claims 18-19, 21, and 27-30, Von Blucher teaches a process for producing granular activated carbon by carbonization, comprising of the plurality of temperature zones and the limitations of steps a, b, and c. of the currently reviewed application (claim 1). The apparatus transporting or conveying means can be through a continuous rotary tube (paragraph 0039 and 0048). Von Blucher also teaches a total residence time of the starting material in the apparatus in the range from 0.1 to 5 hours (claim 9). Finally, Von Blucher teaches a first temperature zone operated at temperatures in the range of from 50 to 200°C, a second temperature zone operated at temperatures in the range of from 100 to 500°C, and a third temperature zone operated at temperatures in the range of from 400 to 1,200°C (claim 9 and 11 as well as MPEP 2144.05 [R.-51 Obviousness of Ranges).

Von Blucher does not, however, teach that the individual temperature zones are separately and independently controlled, as well as the setting of a temperature profile in the individual zones. Von Blucher also does not teach a continuous carbonization apparatus.

Angelo II teaches a continuous carbonization apparatus for the process of continuously carbonizing and activating carbonaceous materials in a series of longitudinally spaced zones with independent regulation of gas and temperature (column 6, lines 52-62 and claim 1). Process control is performed by setting the temperature profile in the individual temperature zones (column 6, lines 52-62 and claim 1).

The motivation for the combination of these two inventions would have been obvious to a person of ordinary skill in the art at the time of invention, as the idea for continuous production of activated carbon has been around since the 1980s (with Angelo II). The addition of divided temperature zones has been shown not only in this field, but several others, including food technology and metallurgy The suggestion or motivation to do so would be for better control of the carbonization apparatus, maintaining distinctions in sectioning rather than subjecting the whole apparatus to changes in temperature.

However, to reach this conclusion, it's necessary to ignore Von Blucher's own teaching and consider how the apparatus taught in Angelo II might be operated, rather than focusing on the actual method taught in Angelo II. Von Blucher et al. teaches a method which is diametrically opposed to the present invention. As can be seen from the specification and claims, von Blucher et al. teaches the necessary separation of the process steps so that each step can be optimized.

Utilization of the method taught in Angelo II in combination with von Blucher et al. would initiate combustion before sulfonation and cross-linking could occur.

Von Blucher's Teaching

At paragraph 0013, Von Blucher describes his process.

> [0013] Applicant has now surprisingly discovered that the problem dealt with by the present invention may be solved by separating from each other the procedural steps required in the production of activated carbon--namely carbonization on the one hand and activation on the other hand--and by carrying out carbonization in a continuous manner while carrying out re-carbonization and activation in a discontinuous manner. In particular, the present invention is based on the separation of the corrosive phase (pre-carbonization step, in connection with SO_2 output) from the high-temperature phase (activation). Applicant has surprisingly discovered that the pre-carbonized starting material is no longer corrosive, i. e. by further increasing the temperature, corrosive agents is no longer be generated.

Subsequently, at paragraphs 47-51, Von Blucher explains that there are numerous reasons for separating the acidic phase from the high temperature or activation phase and provides four of the reasons in detail.

> [0047] The advantages of separating the acidic phase (pre-carbonization) from the high-temperature phase (activation) are numerous:
>
> [0048] 1. The continuously working rotary tube for pre-carbonization can be made of particularly acid-proof types of steel, which are less suitable for high temperatures, whereas the discontinuously working rotary tube (re-carbonization and activation) can be made of steel that is especially suitable for high temperatures. In other words, separation of the comparatively fast, corrosive stage, under the release of a great amount of SO_2 (pre-carbonization), from the comparatively slow activation enables an optimal adaptation of the equipment being used. Since, for example, pre-carbonization in the presence of acid may only require approx. 60 to approx. 120 minutes, whereas the activation, however, takes several hours, the rotary tube for pre-carbonization may have smaller dimensions than the rotary tube for re-carbonization/activat- ion (The long duration in the large rotary

tube for the activation is also the reason why it is not operated on a continuously working basis because the required length thereof would be enormous.).

[0049] 2. Washers (washing devices) for SO_2 may have much smaller dimensions than those of state of the art processes because no SO_2 peaks have to be handled anymore, but SO_2 output is continuous and uniform.

[0050] 3. Regular, continuous output of SO_2 in the process of the present invention allows its recovery, in particular in connection with a catalytic oxidation to SO_3, and, optionally, further conversion into sulphuric acid or oleum, respectively, which can be much more favorably disposed of than sulfite liquor, or may even be re-employed or re-circulated in the process according to the present invention, for example especially when employing precursors of ion-exchangers as starting material.

[0051] 4. The process of the invention provides the opportunity to dispose of waste products, as it is the case for spent ion-exchangers and spent catalysts, and to convert them into useful products, i. e. activated carbon spherules. According to the process of the present invention, highly useful, high-quality, abrasion-resistant activated carbon spherules, are obtained at good yields also from waste materials to be disposed of, which otherwise would have to be disposed of in another way--in particular they would have to be burnt off or stored. Therein lies another advantage of the present invention, especially in times of increasing environmental awareness. Thus, another subject-matter of the present invention is equally a process for disposing of as well as regenerating waste materials.

Angelo II's Apparatus and Related Method

In the first paragraph, Angelo II describes his apparatus:

> This invention relates to new and useful improvements in apparatus for carbonizing such carbonaceous material as wood, coal, agricultural or industrial wastes, and in general any type of animal or vegetable material, to a charcoal form, and subsequently to activate the charcoal by further removal of the heavier volatile components thereof still retained therein. This increases the porosity and surface area of the carbon, and hence increases its adsorptive capacity in its use as activated carbon. The uses of activated carbon in purification operations are of course numerous.

> The provision of an apparatus capable of performing both the carbonization and the activation functions, in a continuous process in a single retort, is the overall object of the present invention.

At col. 1, lines 23-41, Angelo II describes the operation of his device as follows:

> In the present device, the carbonaceous material, in particulate form, is inserted into the upper end of a slightly inclined rotary retort, transported slowly through the length of the retort as a tumbling bed of material by rotating said retort, and the product removed from the lower end of the retort. At the entry end, the material is initially heated by an external fuel to dry it and elevate its temperature to a level at which carbonization commences. Once initiated, the carbonization reaction is self-sustaining and exothermic, giving off large quantities of heat and vaporizing much of the volatile components of the material, which are released as combustible hydrocarbon gases. The heat released is not in itself sufficient to dry freshly inserted material and bring it to carbonization temperature in a continuous process, so air is introduced into the retort in sufficient quantities to combine and burn with the hydrocarbon gases to produce the required heat.

According to Angelo II's description of the method taught, material that enters the apparatus encounters an oxidizing atmosphere that establishes conditions which support the self-sustained combustion of the carbonaceous material. The material is vigorously burning. Such extreme conditions are incompatible with those needed (taught in Applicant's specification) for sulfonation and cross-linking.

Von Blucher et al.'s Teaching Regarding the Importance of Separating Process Steps

In addition to the admonition to keep the process steps separate provided in the specification of von Blucher et al., the importance of separating the respective process steps is also illustrated by claim 1. Claim 1 reads in the characterizing part that polymer spherules are first subjected to a continuous pre-carbonization step and are then discontinuously treated in re-carbonization and activation step. Thus, the method claimed by von Blucher et al. requires a separation of the acidic phase (pre-carbonization) from the high-temperature phase (activation). In this context, von Blucher et al. teach a method utilizing distinct apparatuses optimized with respect to its intended purpose. The necessary apparatuses include a continuously working

rotary tube made of acid-proof types of steel and a discontinuously working rotary tube made of steel that is especially suitable for high temperatures (see paragraphs 0047-0048).

As noted above by von Blucher et al., substantial advantages result from the separation of the different process phases, pre-carbonization and activation (cf. paragraph [0047]: "The advantages of separating the acidic phase (pre-carbonization) from the high-temperature phase (activation) are numerous: ..."). In the following paragraph [0048] von Blucher et al. explicitly state that, in other words, separation of the comparatively fast, corrosive stage, under the release of a great amount of SO_2 (pre-carbonization), from the comparatively slow activation enables an optimal adaptation of the equipment being used." (emphasis added). From the cited portions above it becomes absolutely clear that von Blucher et al. not only contemplates a process which requires the separation of the respective process steps, but von Blucher et al. additionally teaches away from a continuous process carried out in a unified apparatus. As a result, von Blucher et al. cannot serve as a starting point or as a primary reference to support an obviousness rejection. The skilled practitioner motivated by von Blucher et al. would never consider combining the specific process steps within a single apparatus.

The Office Action appears to simply select individual elements from the method taught by von Blucher et al., e.g. the specific process steps such as pre-carbonization and activation and force them into a continuous arrangement to arrive at the presently claimed invention without considering the admonition from von Blucher et al. that the process elements or steps should be practiced in a discontinuous fashion. This arrangement of elements to provide a continuous method can only occur through hindsight and by ignoring the plain teaching of von Blucher et al.

The conclusion reached by the Office Action ignores the fact that von Blucher et al. teaches away from the present invention, requiring the separation of process steps as described above. Thus, it is neither considered possible nor recognized as advisable to conduct the entire carbonization operation within a single apparatus divided into specific sectors as required for applicant's claimed invention. According to von Blucher et al. combining the corrosive phase with the remaining process steps would negatively impact the performance of the resulting activated charcoal and damage the apparatus utilized. Thus in view of von Blucher et al.'s admonition to carry out the carbonization method in a discontinuous manner in order to achieve the numerous advantages indicated and to avoid the cited disadvantages of the continuous

method, one skilled in the relevant art could not foresee Applicant's claimed continuous method starting from von Blucher and any of the additional cited references.

But even if the skilled practitioner – on a mere *arguendi causa* level only – would take the von Blucher et al. reference into consideration, the skilled practitioner would be faced with developing the necessary reactor modifications and establishing the necessary reaction conditions in order to arrive at the present invention. However, the skilled practitioner has no motivation to do this, especially because the prior art provides neither the incentive nor the guidance to assist in developing the presently claimed invention, and von Blucher et al. expressly indicates that this is the wrong way to proceed.

The Proposed Combination of von Blucher et al. with Angelo II would not be considered by One Skilled in the Art

Because Angelo II is completely silent with respect to a sulfonation of the starting material and only provides an apparatus which does not allow for a strict formation of distinct reaction zones, the skilled practitioner would not consider the combination of von Blucher et al. with Angelo II (US 4,273,619 A). Angelo II is only deals with a carbonization process and does not teach how to coordinate a variety of different process steps that require different processing conditions within one and the same apparatus. Further, Angelo II does not describe a complete carbonization operation in the sense of the present invention. Angelo II neither, expressly nor inherently, discloses a carbonization operation which includes the steps of sulfonation and cross-linking prior to carbonization and activation steps in a single apparatus.

Angelo II requires different gases, at least in part, to flow through the carbonization material which results in the mixing with solids and still other gases. As a result, unlike Applicant's claimed process, the individual temperature zones in Angelo II are not maintained as separate zones and independently controlled. This lack of control causes an undesirable mixing of gases. As a result, the ability to accurately control the temperature of specific regions and ability to maintain degradation products (acidic products) in the appropriate regions is compromised. Therefore, neither the method nor the apparatus taught in Angelo II is relevant to Applicant's claimed invention. At the time of Applicant's invention, one skilled in the relevant

art would find nothing in the combination of von Blucher et al. and Angelo II that would have led to Applicant's claimed invention.

The Proposed Combination of von Blucher et al. with Angelo II, and further in view of Schwartz would not be considered by One Skilled in the Art with respect to claims 22-24 and 36-37

US 5,212,144 A (Schwartz) describes a method for the chemical activation of a carbonaceous raw material by incorporating oxidizing agents into the raw material prior to subjecting the particles to an elevated temperature. The sweep gas utilized by Schwartz is completely inert with respect to the material to be carbonized and activated. The sweep gas only serves to remove water and acidic components produced during the activation reaction.

According to Schwartz at column 1, lines 57 to 63, the heat energy is primarily transferred from the combustion gases by their direct contact with the impregnated raw material to accomplish carbonization and activation. In this process the combustion gases also function to convey, or sweep away, the water and acid produced by the activation reactions. The method taught by Schwartz, however, neither teaches or suggests the provision of distinct atmospheres in the apparatus required for Applicant's claimed process. Schwartz, therefore, has nothing in common with respect to Applicant's claimed invention.

The Proposed Combination of von Blucher et al. with Angelo II, and further in view of Digre would not be considered by One Skilled in the Art with respect to dependent claim 20

U.S. Patent No. 5,437,237 (Digre) only teaches a continuous pyrolysis system and doesn't teach or suggest a specific process for producing activated carbon. Furthermore, the pyrolysis is performed in a homogeneous substantially anaerobic environment. The homogeneous atmosphere, in the sense of an inert atmosphere, is unrelated to Applicant's differentiated atmosphere separately populated with specific activating gases under the appropriate conditions to perform sulfonization, carbonization and activation within a single apparatus. Digre is completely silent with respect to this inventive concept and provides nothing to the skilled practitioner that would have prompted him to conceive Applicant's claimed invention.

The Proposed Combination of von Blucher et al. with Angelo II, and further in view of Giebelhausen et al. would not be considered by One Skilled in the Art with respect to dependent claim 26

U.S. Patent No. 6,316,378 B1 (Giebelhausen et al.) describes a discontinuous process for the production of shaped activated carbon by steam activation in an continuously operating rotary tunnel kiln. The Giebelhausen kiln is subdivided into a carbonizing zone and an activating zone (abstract). However, Glebelhausen et al. teaches nothing regarding a sulfonization being performed in the same apparatus. In addition, the raw materials are treated in a separate rotary tunnel kiln and only afterwards transferred to a second indirectly heated rotary tunnel kiln as delineated in Claim 1. Therefore, Giebelhausen et al. is completely silent with respect to this inventive concept utilizing a single apparatus and provides nothing to the skilled practitioner that would have prompted him to conceive Applicant's claimed invention.

Summary

According to the Office Action, the "...Examiner maintains, without hindsight, that a person having ordinary skill in the art at the time the invention was made would have attempted to make the process of von Blucher continuous regardless of the applicant's reasoning to keep as separate units." (page 8 of Office Action) It's important to understand that "Applicant's reasoning" is substantially lifted directly from von Blucher, the primary reference cited by the Examiner in rejecting Applicant's pending claims. Of all of the references cited, only von Blucher teaches a process even related to Applicant's claimed process. Von Blucher specifically teaches that a discontinuous process has numerous advantages over the continuous method suggested by the Examiner (paragraph 47). At paragraphs 48-51, von Blucher indicates that the advantages of his discontinous process are numerous and specifically details four of those advantages. Von Blucher was familiar with continuous processes because his precarbonization step was continuous. All of the cited references except Giebelhausen had been published by von Blucher's priority date. Presumably von Blucher was a person skilled in the art. He neither taught a continuous process nor attempted to claim his process as a continuous process. In view of von Blucher's teaching, it isn't sufficient to simply suggest that the von Blucher process

would be made continuous because continuous process are known and preferred in the art. The issue never properly addressed in the Office Action is why one skilled in the art would ignore the specific teaching of the primary reference cited in the Office Action and knowingly give up the cited advantages for the discontinuous process in favor of potential advantages associated with a continuous method.

As acknowledged in the Office Action, the present invention is clearly novel over the prior art citations. As noted in the English translation of the International Preliminary Patentability, Applicant's claimed invention was both novel and unobvious. Furthermore, in contrast to the opinion expressed in the Office Action, the claimed subject-matter of the present invention is also unobvious over the prior art documents, because none of the prior art documents anticipates or even suggests a combination of the inventive features of amended independent claims.

As discussed in detail above, the skilled practitioner would not arrive at the presently claimed invention starting from the von Blucher et al. reference because it explicitly teaches away from the present invention. For, this reference requires a separation of the respective process steps in different apparatuses. Furthermore, the skilled practitioner would also not consider Angelo II with respect to the preset invention because this document is also silent with respect to the performance of a complete carbonization process including a sulfonation step realized within one and the same apparatus in the sense of the present invention. Furthermore, because of the way air is introduced, the provision of distinct temperature and atmosphere zones as performed by the present inventions is contravened by Angelo II. Separately or in combination, the cited documents could not guide the skilled practitioner to the teaching of the present invention. Furthermore, the prior art documents of Schwartz, which only refers to a chemical activation using homogenous atmospheres, Digre, which only refers to a pyrolysis system using an inert atmosphere within the apparature, and Giebelhausen et al., which also point to a separation of the process steps fail to contribute anything with respect to the present invention.

The shortcomings of the cited references are even more striking with regard to pending Claims 36 and 37 requiring the presence of specific locks. For example, von Blücher et al. teaches the need for separate process steps. According to the method of Angelo II with the

injection of air, distinct reaction regions as provided by specific locks cannot be performed. Finally, Schwartz only refers to chemical activation processes and the facultative locks are only used within such activation process.

Angelo II has similar shortcomings. Unlike the von Blucher reference involving a separate sulfonation step, Angelo II teaches a completely different process lacking a sulfonation step. In addition, the apparatus used in the method of Angelo II results in significant mixing of air and reaction gases within the apparatus which is e.g. problematic with respect to the distribution of acidic gases within the apparatus because such mixing diminishes the quality of the resulting active charcoal. Because Angelo II was filed in the late seventies, the information it contains was available to von Blucher when he filed his application in the late nineties. Although several cited documents are relatively old, a skilled practitioner never considered combining these references to achieve Applicant's claimed invention, which is clear evidence for the unobviousness of the claimed invention.

Applicant respectfully asserts that the skilled practitioner would lack any motivation to combine the cited references, but even if the combination were made the skilled practitioner would not arrive at the present invention because all of the references are completely silent with respect to the provision of a method wherein the entire process for attaining activated carbon is performed within a single apparatus. Applicant's claimed method only comes into focus from Applicant's specification through hindsight.

Applicant has provided, for the first time, a process for producing granular carbon starting from suitable carbonization polymers wherein the entire carbonization process, with its various process steps is carried out in different sectors in different atmospheres and at different temperatures within just a single apparatus. This inventive concept leads to a continuous carbonization operation leading to activated carbon without any interruption within a single apparatus. This process is simpler, more efficient, and provides cost savings.

In view of the above remarks, it is respectfully submitted that the present application is in condition for allowance and an early notice of allowance is earnestly solicited. If after reviewing this response the Examiner feels that any issues remain which must be resolved before the application can be passed to issue, the Examiner is invited to contact the undersigned representative by telephone to resolve such issues.

Respectfully submitted,

By Edward E. Sowers

Edward E. Sowers, Reg. No. 36015
Woodard, Emhardt, Moriarty,
McNett & Henry LLP
111 Monument Circle, Suite 3700
Indianapolis, Indiana 46204-5137
(317) 634-3456
Email: esowers@uspatent.com